

An energy saving device for television transmission highlights technology transfers in energy supply and conservation

In 1952, the Federal Trade Commission adopted the dual-band system for television broadcasting, opening up the ultra high frequency (UHF) range in addition to the earlier established very high frequency (VHF) system. The number of UHF-TV stations on the air has grown steadily, from only six in 1953 to more than 400. But UHF-TV was born with a handicap that has never been corrected: UHF stations need greater transmitter power for adequate reception than is required for equivalent VHF reception and, additionally, the efficiency of UHF transmitters is inherently much lower than their VHF counterparts. As a result, UHF station operators must pay, on the average, about four times as much in electric utility costs as VHF stations, a substantial competitive disadvantage.

UHF electricity costs could be sharply reduced if there were available power amplifying devices with efficiencies comparable to those of VHF. Such a development is the aim of a NASA technology utilization program involving adaptation of space technology to UHF transmissions; the program is being conducted by Lewis Research Center (LeRC) in cooperation with the UHF-TV broadcast industry.

The project is based on work in the early 1970s by LeRC's Dr. Henry Kosmahl, who developed a radio wave amplifier to improve efficiencies of communications satellite transmissions. Called a Multistage Depressed Collector, or MDC, the amplifier allowed satellites to transmit more powerful signals, thus making possible the use of smaller, less costly Earth terminals for signal reception. Dr. Kosmahl later

conducted preliminary research on adapting the MDC to boost the efficiency of UHF-TV klystron transmitters.

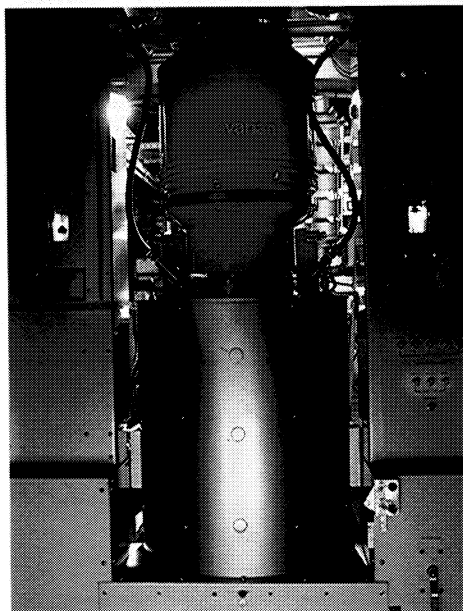
The klystron is a vacuum electronic tube used to generate and amplify ultrahigh frequencies for broadcasting TV signals. The klystron abstracts radio frequency energy from a high voltage electron beam when amplifying UHF-TV signals, but it does so at a low level of efficiency; on the average, only 10-15 percent of the beam energy is converted to radio frequency energy. The rest is dissipated as heat, mostly dumped into cool water. The concept behind the LeRC development program is that the MDC could recover much of the energy being wasted by recycling a large part of the electron beam energy. LeRC feels that efficiencies up to 30 percent can be attained by modifying klystrons to incorporate the MDC and another Lewis development—a spent beam refocuser—that changes the magnetic field shapes of electron beams in a manner designed to aid the energy recovery function of the MDC. Efficiency gains of the order contemplated would result in energy savings of 50 percent for UHF-TV stations.

The MDC klystron development project is being conducted, under LeRC contract, by Varian Associates, Inc., Palo Alto, California, the largest manufacturer of UHF-TV klystron tubes in the United States and Canada. Jointly funded by NASA, the National Association of Broadcasters and Public Broad-



casting Systems, the program is in the second year of a planned three-year effort. The initial design and materials selection phases have been completed and 10 experimental MDC klystrons are being built and tested to demonstrate their performance capabilities.

If the development effort proves successful, it would offer benefits of significant order to the UHF-TV industry. A typical 200,000-watt UHF-TV station in a medium-to-large metropolitan area spends some \$300,000 a year on electricity; thus the target efficiency of 30 percent for MDC klystrons would allow a saving of \$150,000 for the typical station, an estimated \$45 million a year nationwide. ▲



Above, an engineer of station WETA-TV, Bethesda, Maryland, is checking an experimental advanced klystron prior to installation; the installed klystron is shown at left. Klystrons generate and amplify UHF-TV broadcast signals; a NASA/industry development program seeks to improve klystron efficiencies for large-scale savings in energy costs.